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Re: Comments on Proposed Decision to Add Waters to Oregon's 2010 Impaired Waters List

Please accept these comments urging EPA to identify *all* of Oregon's coastal waters as threatened or impaired by ocean acidification under section 303(d) of the Clean Water Act. The Center for Biological Diversity supports the addition of the proposed low-pH waters to Oregon's impaired waters list, and we believe that listing all of Oregon's coastal water segments is warranted.

The oceans are becoming increasingly acidic faster than they have in the past 300 million years, a period that includes four mass extinctions (Honisch et al. 2012). The last analogous ocean acidification event, about 55 million years ago, resulted in the extinction of about 95% of marine species. Now, the rate of carbon dioxide increase is about ten times anything in the geologic record. Ocean acidification threatens not only ocean life, but also the economy. A conservative estimate of the damages that our oceans will face from carbon dioxide emissions—including effects on fisheries, tourism, and from sea level rise—at $428 billion per year by 2050. The Pacific Northwest's shellfish industry alone has much to lose valued at $278 million (Barton et al. 2012).

The worst consequences of ocean acidification are still avoidable, yet we must act *now* to address this problem. EPA has a duty to protect our ocean water quality and needs to provide bold leadership in approaches to prevent the harmful consequences of ocean acidification.

EPA's inclusion of Hall Slough, Hoquarten Slough, and Noble Creek as impaired for low pH levels demonstrates EPA's capacity to identify and list acidified waters, and we applaud EPA for these additions. EPA has taken a necessary step towards acknowledging the water quality threat of low pH conditions on Oregon's waters, and must be commended for analyzing the additional data it considered, including thousands of pH measurements. EPA should acknowledge whether or not these listings are due to ocean acidification. <u>Most</u>

importantly, for these three listings EPA should identify ocean acidification as a source. Even if factors in addition to CO_2, such as polluted runoff, contributed to the low pH levels all anthropogenic sources require attribution.

In a study of a large estuary complex, scientists attributed 24-49% of the decline in pH relative to pre-industrial values to ocean acidification (Feely et al. 2010). This is an analog for estuary waters such as Hall Slough, Hoquarten Slough, and Noble Creek; while some pH change may be ascribed to organic matter and pollution runoff, these waters are substantially affected by the contribution of anthropogenic CO_2 and the resulting ocean acidification. By the end of the century, scientists predict ocean acidification may become the dominant process reducing the pH and aragonite saturation state of estuaries, accounting for 49-82% of the pH decrease in subsurface waters (Feely et al. 2010).

Additionally, EPA must consider aquatic life parameters, beyond pH levels, that are not being met due to ocean acidification. Oregon's standards that marine waters must have a pH between 7.0 - 8.5 and estuarine waters between 6.5 - 8.5 units, OAR 340-041-0021, is inadequate to protect the state's beneficial uses for aquatic life and fishing, O.A.R. 340-41-0230 tbl.230A; O.A.R. 340-41-0220 tbl.220A; O.A.R. 340-41-0300 tbl.300A. This is not even as stringent as EPA's water quality criteria that limits pH change to less than 0.2 units beyond natural levels (which is also insufficiently protective to address ocean acidification, see Zeebe 2008). Oregon requires that water be free from dissolved carbon dioxide in quantities that is deleterious to fish or other aquatic life." O.A.R. 340-041-0007(11). Additionally, water quality must be maintained at its highest possible level and, minimize "dissolved chemical substances" and "other deleterious factors," O.A.R. 340-041-0007(1), and prohibit "[t]he creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life."' O.A.R. 340-041-0007(11). These standards are not presently being attained due to ocean acidification.

The peer-reviewed, scientific studies concerning ocean acidification that we submitted for Oregon's 303(d) 2008 and 2010 list demonstrate that Oregon's coastal waters are threatened and impaired by ocean acidification; those data are incorporated here by reference. In addition, we would like to point you to a new repository of environmental data, including parameters useful for obtaining ocean acidification information, that EPA should evaluate for ocean waters; the National Oceanographic Data Center is operated by NOAA and can be accessed at www.nodc.noaa.gov.

In this comment, we will take the opportunity to describe the most important new study, Barton et al. 2012, that supports 303(d) listing for Oregon's waters. Additionally, we have enclosed some of the most relevant, Oregon-specific information with this letter that was previously submitted.

Beginning in 2006, natural and hatchery larval production of certain oysters in the Pacific Northwest has experienced severe declines. These problems threaten Oregon's coastal ecosystems, as well as the economically important shellfish hatchery industry in Oregon and Washington. The problems have coincided with strong upwellings bringing corrosive waters near shore (Barton 2009). Oyster hatcheries on the Oregon and Washington coast report repeated failures of up to 80 percent of oyster production due, in part, to waters affected by ocean acidification (Barton et al. 2012; Miller et al. 2009).

Importantly, anthropogenic carbon dioxide has provided enough additional CO_2 to the waters to cause widespread corrosiveness on the continental shelf along Oregon's coast (Feely et al. 2008, Juranek 2009). The aragonite saturation horizon has shoaled by about 25-40 meters due to the CO_2 signal, which is exposing marine life in the surface waters to corrosive conditions (Feely et al. 2008). Notably, the waters that are upwelling along the Oregon coast were at the surface more than 50 years ago, so there is already considerable additional carbon dioxide in the pipeline (Feely et al. 2008).

Barton et al. have now definitively linked the devastating oyster mortalities in Oregon to ocean acidification. Specifically, the study found that oyster larvae had difficulty with growth and production in waters with elevated CO_2 . In response to reported shellfish hatchery problems in Oregon, Barton et al. reported the results of their observations from the Whiskey Creek Hatchery on Netarts Bay in the summer of 2009 (Barton et al. 2012). Notably, this study analyzed calcifying organism responses in the naturally fluctuating ambient-water CO_2 chemistry of Oregon's coastal upwelling system, a study reaching beyond the laboratory to actual observation. Larval production and mid-stage growth (~120 um to ~150 um) of the oyster, *Crassostrea gigas*, were both significantly negatively correlated with the aragonite saturation state of waters in which larval oysters were spawned and reared for the first 48 hours of life. The study demonstrated that during times of low aragonite saturation, larval oysters experienced adverse effects. Although the impact of the exposure was not immediate, the delayed reaction caused a significant decline in growth for mid-sized oyster larvae and reduced overall production. The findings corroborate other laboratory studies that show that many marine species, especially at the larval stage, are adversely affected by ocean acidification.

The intake waters on the Oregon coast experienced variable carbonate chemistry (aragonite saturation state <0.8 to > 3.2; pH <7.6 to >8.2) in the early summer of 2009, and the data presented reflected the conditions in the ambient bay waters at the intake for the hatchery. The results highlight how variable acidification may affect coastal and estuarine ecosystems, and that the timing of spawning is critical in light of variable local conditions occurring on top of a shifting CO_2 chemistry baseline. Moreover, the study should be considered a conservative estimate of the impacts of acidification on oysters because they are reared in ideal conditions in a hatchery setting, and not exposed to predation or other stressors in natural habitat.

This new study of the Whiskey Creek hatchery further demonstrates that the waters in Netarts Bay and along the Oregon coast, which are being bathed in corrosive waters during the upwelling season, are impaired by ocean acidification and should be included on the 303(d) list. Because water in transit to upwelling locations has been exposed to more recent, higher CO_2 atmospheres, Oregon should expect increasingly corrosive upwelled water to continue to affect larval oyster production in the future.

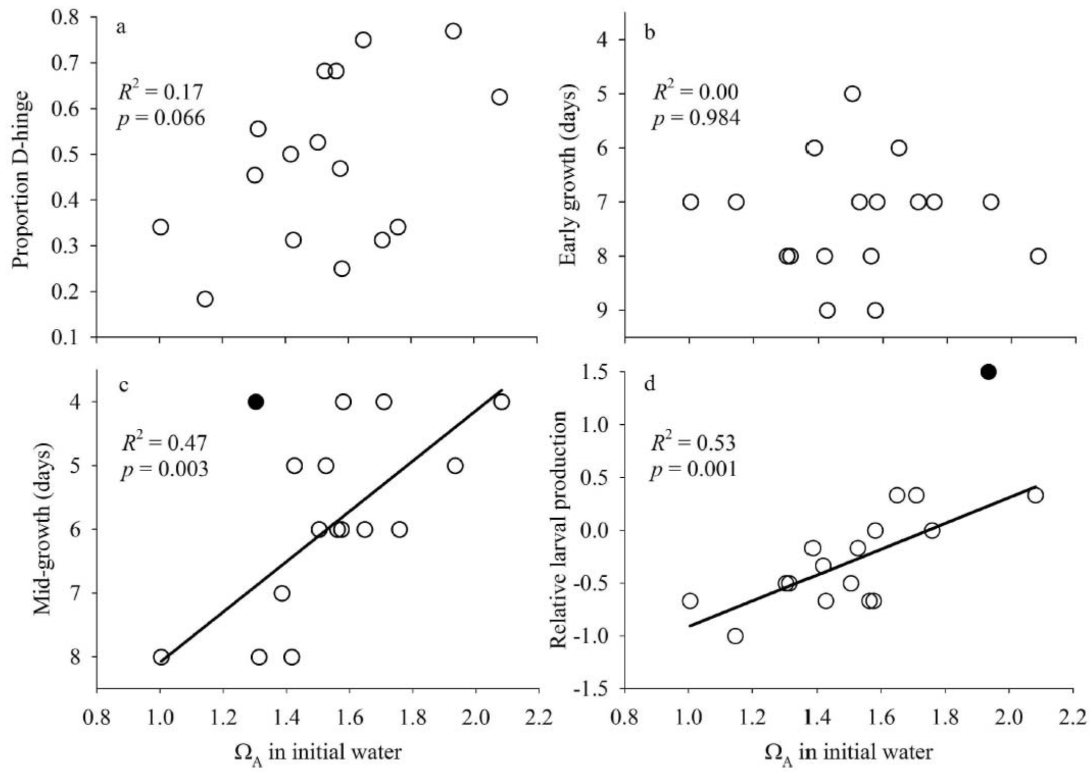

Fig. 5. Relationship between saturation state of aragonite and (a) proportion of larvae developing to D-hinge stage, (b) number of days for larvae to reach a nominal 120-μm size, (c) number of days for larvae to grow from 120- to 150-μm nominal size, and (d) overall relative production of each cohort. As described in the Methods section, relative production does not include the changes in the cohort prior to D-hinge; relative production captures only the changes from the D-hinge stage up to competent to settle. Data points in black on graphs 5c and 5d are statistical outliers and were excluded from regression analysis. Reduced R^2 values and p-values of linear regression analyses are shown in the figure. Other statistics for significant relationships are (c) midstage, growth slope = -3.95 ± 1.05 days, intercept = 12.02 ± 1.67 days and (d) relative production, slope = 1.22 ± 0.29 days, intercept = -2.13 ± 0.44 days.

In conclusion, the threats of ocean acidification are real, and they are adversely affecting Oregon's aquatic life today. Under a business as usual scenario, acidified waters will continue to damage the calcifying organisms that inhabit Oregon's coastal waters and will have devastating impacts on the entire marine food web. EPA must consider these comments, recent studies, and reports as well as other scientific information included herein, and take prompt action to identify Oregon waters threatened or impaired by acidification.

Sincerely,

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Enclosed

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